ARE SUBTERRANEAN GASES CAUSE OF PANAMA CANAL SLIDES?

Former United States Senator Thomas Kearns of Utah Advances New Theory of Cause of the Trouble on the Isthmus and Backs It Up With Facts From Thirty Years Experience in Mining

Former Senator Thomas Kearns of Utah recently visited the Panama Canal in company with his engineer by invitation of a high Government official. On his return he was requested unofficially to put into writing his conclusions as to the cause of the so-called slides at the canal. His statement of the situation is given herewith.

By THOMAS KEARNS,
Formerly United States Senator From Utah.

ONE of the important questions if not the most important, in the minds of the American people to-day is "Will the great waterway, the Isthmian canal, prove a success or is it a failure?" It means everything to us, not only from a commercial standpoint, but from a protective standpoint, for it makes it possible for Uncle Sam's great fleet to pass from the waters of the Atlantic into the Pacific, upon a few hours' notice and so saves the expense of maintaining two great fleets instead of one.

On account of the unfortunate present conditions in Europe and the insistent demand of the majority of Americans for preparedness, many of our people are asking: "Are we going to be able to keep the great Isthmian canal open or will it continue to fill up?" There are grave reasons for asking this question, for since it was first opened to navigation on August 14, 1914, it has been closed and out of commission virtually two-thirds of the time.

Many great minds are asking the question: "If this canal condition continues, should we abandon it altogether and construct a sea level canal at Nicaragua?" To my mind this would not help the situation. If similar conditions are encountered in Nicaragua at sea level, we should have there a harder problem to solve than the present Panama lock canal. There would not be the same opportunity to remove the cause. In my opinion the problem can be solved; the canal will be a success and the movements of the earth that are at present filling up the Culebra cut can be overcome.

After close personal investigation and careful study, in company with my engineer, who has been in my employ for twenty-six years and who has solved many similar problems, though smaller, of course, I am fully convinced that subterranean gases coming from below are causing the trouble—not soft material underlying the hillsides, nor the weight of the banks, as is maintained by most of the eminent engineers and critics who have ventured to give their opinion.

Recently Governor George W. Goethals of the Panama Canal zone was quoted as saying that work had begun on the removal of from six to eight million cubic yards of rock and earth from the banks of the great Culebra cut. This work is now well under way and close to one million cubic yards per month are being removed. At this rate the work should be completed some time in the fall.

The purpose of the removal of this immense amount of material from the banks of the great cut is to cause a definite and complete cessation of the annoying, so-called slides that have so interfered with the operation of the canal as to cause a growing doubt in the minds of the American people of the real efficiency of the canal which has cost the Government, up to the present day, close to $500,000,000. This method of working for the solution of the so-called slide problem there has the approval of nearly every engineer who has studied the matter, and the American people fervently hope that the engineers are correct.

At the risk of the disapproval of many eminent engineers who are familiar with the conditions, I disagree with those who believe that, when the eight million cubic yards of material mentioned are removed from the banks and the weight taken off the question is solved. It will make but little, if any, difference in the filling of the Culebra cut from the bottom, and I venture the prediction now that after the banks are so lowered and the amount of dirt above mentioned has been removed and the dredges have finished their work and have been taken from the cut there will be a repetition of the filling from the bottom and sides within ninety days. Islands of mud and eruptive rock will again begin to appear above the surface of the water, just as they appeared when they so effectively closed the canal some months ago.

Let us suppose for a minute that I am correct in this prediction. What is then to be done? Must the canal, which involved so much labor and expense and which means so much not only to the American people but to the convenience of the world, be abandoned as useless? Surely it would seem that the greatest engineers that America has produced would have exhausted their talents in their efforts to stop the so-called slides—and that they will have failed in their theory.

In my humble judgment, the situation would not be so serious as one might fear. It is a fact that the army engineers have accepted the theory of the earth's "sliding by its own weight" into the canal and are proceeding in accordance with this theory, and until such time as the 3,800,000 cubic yards have been removed and the banks cut down to where the weight has been taken off, it would be useless to suggest any other remedy. Those estimates were made about February 1 of this year and the work should be well toward completion by October 1. I sincerely hope that the engineers are correct in this theory and that the problem will be solved so that the canal may remain open after that date.

Of course this proviso was made with that certain condition—that it would solve the present difficulty, but if the two highest points within the area of movements known as Gold Hill and Contractor's Hill (which were one and the same hill before the channel was cut through) should develop a movement into the canal it would add to the difficulty. There would then be many additional million cubic yards to be moved.

However, in my judgment, from observation and the nature of the rock in those particular hills, they will not experience any such trouble from those points. The movements are all within a space of about 2,500 feet, or about half a mile, and my firm belief is that the trouble is all caused by subterranean gases formed in the earth which, when permitted to escape through certain channels or breaks in the earth, carry with them eruptive material, sometimes for a long distance, to the place of the least resistance.

My conclusion is based on somewhat peculiar personal experiences with similar earth movements encountered in mining operations and my opinion is not formed all from theory. It is based mostly on practice and experience. Are there gases confined in subterranean channels that have burst through the earth's crust at the Culebra cut and produced earth waves which have caused such havoc at that point in the canal? In my judgment it is possible to trace this zone of disturbance and then to tap the gas chamber beneath the rocky ran and so relieve the pressure at that point.

As far as my investigation has gone and from all knowledge I can gather neither the French Government nor our own Government thought it worth while to determine the character of the rock and subsoil through which the canal was constructed.

A little more than 400 years ago Balboa climbed the mountain range at the Isthmus of Panama and beheld the great Pacific Ocean. Almost immediately the idea of constructing a waterway across the Isthmus of Panama was conceived. Since that time every generation has looked into the feasibility of a canal at Panama, but from Balboa to Goethals no one ever made a comprehensive test of the formations below the surface, either by boring or shaft sinking, which should have been made at least 500 feet beneath the water level, that they might know what foundation the canal bed would rest upon.

When a business block, a railroad or a great bridge is to be constructed, the first thing that the owner or contractor does is to learn all about the ground on which it is to stand. The contractor, as well as the owner, desires to know the character of the soil or rock, that he may determine the cost of excavation, and he also must know that he has a firm foundation on which his building or bridge is to rest. Yet building contractors in New York and other cities spend more money in determining the nature of the ground beneath a prospective skyscraper than did the Government of the United States in determining the character of the soil or rock beneath the channel of the Panama Canal.

If corporations or private individuals prosecuted their work in this manner there would be more failures than there now are. Personally, I think that the first million dollars should have been spent on a thorough test of the formation, at least to a depth of 500 feet below the channel, the same to mark the first page of the great undertaking, and I firmly believe that a similar test, in a lesser degree, say to a depth of 500 feet, will yet have to be made in and across that particular section of the Culebra cut. That is, of course, providing the present theory of the engineers fails and the removal of the weight from the banks fails to remedy conditions at the canal.

Time and the expense now being incurred should prove to the public that subterranean pressures and gases are to a large degree causing the trouble. This should be determined within a short space of time, say, the first of the coming year.

To a practical geologist, a great break in the formation at the place of the greatest disturbance is visible, crossing the canal itself almost at right angles. This break should be carefully tested and followed and absolutely located at its source, which may be some five or six miles away, and there relieved of its constantly accumulating gas pressure, which is now forcing its way and carrying with it great quantities of eruptive material to the place of least resistance, namely, into the bottom of the canal at the Culebra cut.

A trained, experienced and practical mining engineer, who has encountered such difficulties on a smaller scale, should be able to follow the rocky signs so potent with meaning to the trained eye, which would enable him to follow the course of this fault plane with certainty. Drilling along the course of this fault, I believe, would establish the fact that this break in the earth's crust is filled with porphyry, eruptive material and soft clay, similar to that found in other sections of the country where eruptions of this kind are not uncommon. Drilling, I believe, also would determine whether or not there was gas along the fault.

Let us admit for the moment that my judgment is correct. It is not unreasonable to suppose that if gas was confined in subterranean caverns or old and extinct craters it would seek to escape at a point where the resistance was the least. If the channel was open and the material soft it would not cause a tremendous upheaval if it could escape along the crack in the earth's crust, loosely filled with clay and eruptive rock.

The presence of this crack or break indicates a previous eruption of confined gases. Now the great Culebra cut, made in digging the canal, must have further reduced the resistance offered to the gas struggling to escape, so that it would seem not altogether unreasonable to inquire whether or not the so-called slides at this point were not in reality caused by earth waves, sympathetic seismic disturbances, due wholly to the presence of the gas beneath the bottom of the canal at this point. When those movements came the banks of the canal shook—a great deal of stone and earth, it is true, slid into the canal, but the greater part of the trouble was due to the earth in the bottom of the canal rising up to the surface of the water and filling the canal and forming islands amidstream.

The theory of the canal engineers is that beneath the rock through which the canal is cut there is a substratum of mud and soft earth. The weight of the rock and earth on either side of the canal, resting on this soft layer of mud, causes it to ooze into the canal, and thus produces the greater part of the trouble. Their remedy for this is to reduce the weight on top of the mud, that is, cut down the bank on either side to almost water level for some distance back, until an "angle of repose" is reached.

It is with this hope that the engineers are now removing an immense amount of earth and rock from the Culebra banks. In support of this theory the engineers call attention to the fact that at a point in the canal where a smaller disturbance occurred the banks were cut down and there was no repetition of the trouble, thus constituting a strong presumption that the proper cure for the so-called slides had been found. However, there is ground for the conclusion that the reason the smaller movement stopped was because the larger movement at Culebra had begun.

The gas, escaping easily at Culebra, ceased to go onto the other plane and cause eruptions there.

Suppose a broken water pipe in a house is flooding the bathroom. If the water main, with which the water pipe is connected at some point beyond the house be severed, the water will discharge at the point of the break in the main and cease to flow in the bathroom. It will not mean that the leak in the water pipe has been repaired, but that the water has found another and larger opening through which to escape. Once it is established that the gas beneath the canal bottom causes the islands of mud and rock and material to rise to the surface the remedy of course would lie in finding some other way or place for those gases to escape.

Again, for comparison, the water tap in your house is broken or out of commission in your bathroom and you are unable to locate where the main water pipe enters your lawn. You get a pail and continue to dip the water out of the tub to keep it from flooding the house. You may continue to dip as long as the water runs. If you cannot locate the feeder or connection to your main you must go to the reservoir and there shut off the main. When the reservoir overflows, change the course of the water so that it will not interfere with your residence.

This is the condition at Culebra cut. They can continue to remove this moving material that is filling up the waterway with their great powerful dredges and hold back the flow for a time, but unless the supply is changed to some other course at the source it may never stop until nature changes it.

Of course I am well aware that there are many sceptics who will insist that the cause and the remedy that I have suggested are unreasonable. I am aware too that the fact that most eminent engineers have held otherwise is not a strong recommendation for such a theory. However, I am reminded that some of the most eminent of the world's geologists have been reversed by nature, and it is not beyond possibility that they may again be wrong, as there are many of the earth's geological conditions that are yet unwritten.

It will doubtless occur to one that if there is anything in the theory I have advanced it is strange that no one of the canal or army engineers has advanced or investigated such a possibility. That is just what occurred to me, and it is a fact beyond dispute that Gen. George W. Goethals and his staff of army as well as civil engineers are among the best and most wonderful construction engineers that the world has ever produced. The construction, the finish, the perfect completion of the locks and the canal itself command the admiration of the world. They served their purpose well and their great efforts must not fail.

There is a problem yet to solve which is no fault of theirs. They are educated, refined and able gentlemen. They extended every courtesy to me and my engineer; they gave us the courtesy of the Government railroad; they extended to us the best of the Government electric launches to investigate every inch of the Culebra cut and the disturbances therein. They freely granted every privilege and every convenience to make the investigation and freely sought any information or suggestions that might tend to solve the problem which is causing the unfortunate conditions at the Culebra cut and preventing passage in the world's greatest waterway and the greatest enterprise that has ever been undertaken and built by human hands.

They even placed at our disposal one of the best geologists in the Government service—an eminent and able gentleman now connected with the geological department in the bureau of mines—Donald F. MacDonald, who willingly exchanged his ideas and gladly considered any that we had to offer. While I could not agree with some of his opinions regarding the situation, yet I respect and admire his ability, but still cling to my own ideas, which can only be considered after the present theory fails.

While the college men have had every advantage from a scholarly standpoint one must make some concessions for the man who has acquired his knowledge and education to a great degree and was trained from early life by actual contact with geological conditions, who has been forced to solve these problems involving the actions of the earth with which he was confronted and who has had long years of experience in combating them.

Those eminent gentlemen mentioned above may not be mining engineers. They may never have had the opportunity of many long years of underground experience and they too, in time, may be willing to concede to the practical fellow some knowledge along those lines.

My experience with gases covers thirty years in mines and underground work in almost every capacity from general manager of large productive properties down to tool boy, when I was first employed underground. This period includes experience in Utah, as well as the five adjoining mining States. It is that knowledge and experience with careful study and many tests and the analyses of eruptive rocks that has induced me to place before you some facts in my experience.

For instance, there is a shaft in Park City, in the State of Utah, at the present day known as the No. 2 Ontario three compartment shaft. There was taken out in the excavation and sinking of this shaft some 12,000 cubic feet of materials per hundred feet of depth as it was originally sunk. Afterward 18,000 cubic feet of material was taken from 100 feet of this shaft each year for fifteen years. A crew of men was employed continuously behind those timbers to keep the shaft open. Oregon fir timbers, twelve inches square, would be broken sometimes over night. The shaft was sunk some 1,500 feet.

The whole shaft was not closed up nor moving, but different sections therein. In one section of 300 feet the management cut around ten or twelve feet of space behind the timbers, putting head boards and braces to steady the timbers. These would sometimes stand for thirty or sixty days, and at occasional periods only over night. This whole breast of rock would move, crushing the timbers in the shaft and wedging itself in there so closely that powder would have to be used to remove it.

There was no visible means of finding out where the rock came from and no known space made vacant by the supply it was furnishing, but the movement was continuous, to my knowledge, for fifteen years, until the shaft was abandoned. The reason for keeping it open for this long period was that it was producing over a million dollars net in precious metals every year. It was then owned and controlled by Haggin and his associates.

Another experience in the old mine known as the Crescent, in the same district. In driving a tunnel, the track in the bottom would sometimes rise two feet over night. We would remove the material and replace the track and it might stand for thirty days, and then the movement would start again and the whole drift would crowd in.

One morning a shift of men under my supervision went into the face of this tunnel to drive ahead, and the timbermen completed and installed, just behind the men, a set of twelve inch square Oregon fir timbers. At 11:30 A. M. the movement came and broke those timbers like matches, and the men on the outside had to dig around the bottom of the timbers in order to get the men out alive. This set of fine new timbers had only been in place and completed three and one-half hours.

I took one of the foremost geologists in this country in there to investigate. He informed me that it was the great pressure of water above and behind this porphyry or eruptive rock that was causing it to swell. I believed it for a time, and I drove on ahead until we struck another vein of the same kind of material, and when I visited my men one morning they were then in a hard formation between the two eruptive breaks, or so-called veins.

The tunnel they were working in was about five by seven feet. The formation was a hard, silicious limestone with small specks of porphyry, or trachyte, appearing in it, and the breast was popping or cracking like cannons on a battlefield. Little, thin scales of rock were breaking off the face of the drift, as thin as a pane of glass.

We were puzzled to know what caused the noise. There must have been some tremendous pressure behind that was causing the chipping off of the rock in the face of the drift. They drilled on some twelve feet further and the drills passed into soft material. When they did a terrific pressure of gas came out of the drill openings.

They asked me to come in. They said that there was an air channel and a terrible pressure of air coming in. They did not realize it was gas and could hardly conceive it was an air channel, because they were 800 feet vertically below the surface.

The gas was soon discovered, because four or five of the men were overcome by it in a few minutes and had to be carried out by fresh men. Of course the men could smell and realized that the air was not fresh, but they thought that the gas had come from the powder that had been used there a few hours before.

We now have drifts in this same property that have been abandoned because there was no mineral passing through them, where hundreds of feet are absolutely closed up. In order to open them again we would have to use as much powder as we did in the original excavation, and the only way that one would ever know there had been a drift there would be by finding the timbers in places smashed into splinters and in the cracks and splinters the rocks wedged as tightly as they were before the ground was first opened.

I am working a shaft known as the Halifax at Tonopah, Nev. It is now 1,700 feet deep. There is one section about 300 feet thick in that shaft about 700 feet below the surface that has to be retimbered and eased off on account of the peculiar formation it passes through. This rock is moving all the time. There are numerous places that I personally came in contact with in Eureka, Park City, Tonopah and other mining camps where this same condition exists and it is impossible to keep an opening or passageway clear unless you are continuously working at it.

My first trip to the isthmian canal was about February in 1914. They were then operating the great dredges in the Culebra cut. Seeing the dirt and material coming up from beneath the water and observing the character of the rock, it occurred to me that they too had come in contact with subterranean troubles and difficulties, and I got some of the rock and had it analyzed. I then put my engineer to work, going to Park City and different points where we had those troubles with eruptive rock, filling in with unlimited material and the gases suffocating the miners.

After my experience with the gases and the drift filling in for great distances I began to doubt the theory of the geologist who had informed me that the pressure was in the rock itself that it was a swelling material, through the weight of water pressure, that was causing this trouble. We took sacks of this material from the places that we knew were continuously moving, also the places that had been filled up. We kiln dried and roasted it and pressed it in squares, put it into glass cases and turned water back on it under pressure until we were fully convinced that the theory was wrong. There was no expansion in the rock whatever.

When it was kiln dried and roasted and water put back onto it it did not even expand enough to break the glass.

We also analyzed these rocks, as we did the rock from the Culebra cut. We found the ingredients about the same. These eruptive, or moving, rocks seem to come from the same source, from the same cause and are made up of the same material.

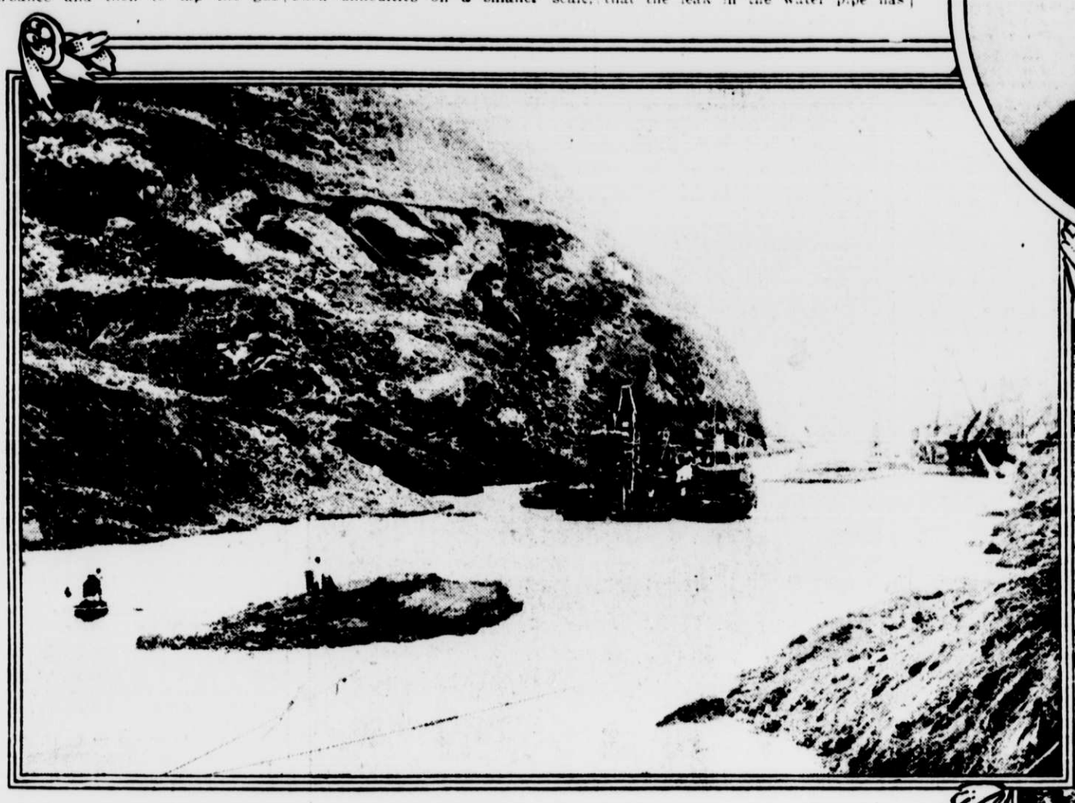
Stop and think what causes the shocks and tremors which occur every few weeks—what shook down San Francisco and what caused cracks in the earth close to Santa Rosa, fifty miles away, where gas discharged for days from openings 500 feet long, where there was never an opening before?

These and many other comparisons would tend to convince any thinking man that in Central America as in Panama, which is more subject to shocks and tremors than any other part of America, there is some reason in the theory that I have advanced.

Should time prove that this theory has merit worthy of consideration and there is anything I can do those in charge have but to command me. My interest in this is merely patriotic, with sincere good wishes for the success of the isthmian canal. I have watched it closely since the American Government secured ownership thereof from France. I had the honor of sitting in the Senate of the United States as a member from the State of Utah. I favored the building of the great enterprise when the purchase was made.

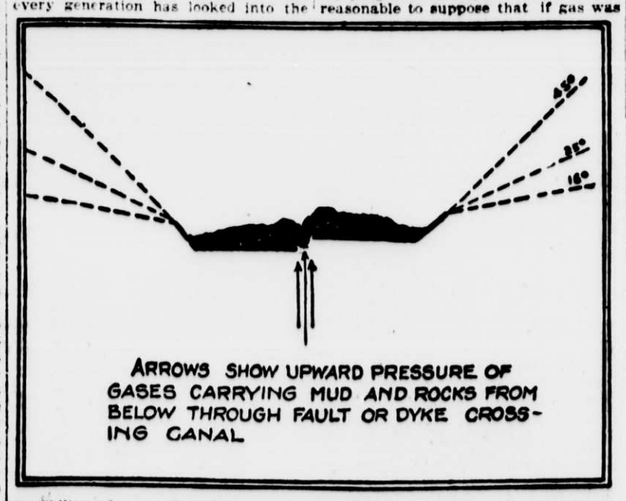
Gaillard Cut, Culebra, looking north from Contractor's Hill. The picture shows the barrier across the canal.

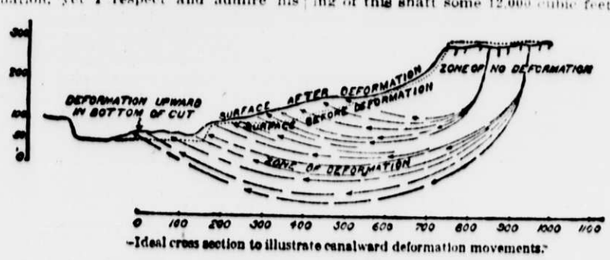
Former United States Senator Thomas Kearns.



One of the troublesome islands pressure from below raises in Gaillard Cut. Occasionally these islands rise ten or twelve feet over night.

Immense masses of earth and rock thrust up in Gaillard Cut north of Gold Hill and suggesting that the cause of the so-called slides may be found in the action of subterranean confined gases.





"Ideal cross section to illustrate canalward deformation movements."